REMARKS

Claim Status

Claims 1-21 are currently pending. Claims 1, 4, 5, 8, 9, 11-17 and 19-21 have been amended to correct minor claim wording. Claims 22-26 have been added. No new matter has been added by way of this amendment. Reconsideration of the application, as amended, is respectfully requested.

Brief Overview of the Disclosed Subject Matter

A light-emitting diode chip with an epitaxial semiconductor layer sequence has an active zone that emits electromagnetic radiation, and an electrical contact structure comprising a radiation-transmissive electrical current expansion layer, which contains ZnO, and also an electrical connection layer. The current expansion layer is applied on the same layer of the semiconductor layer onto which the connection layer is applied (see par. [0035] of the originally-filed specification).

Patentability of the Claims Under 35 U.S.C. §102(b)

Claims 1-5 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,717,226 ("*Lee*"). Applicants have carefully considered the Examiner's rejection, and the comments provided in support thereof, and respectfully disagree with the Examiner's analysis. For the following reasons, Applicants respectfully assert that all claims of the present application distinguish the invention patentably over the cited reference.

Claim 1 has been amended to recite the limitation "the current expansion layer is applied on a cladding layer of the semiconductor layer and comprises a window, in which the connection

layer is applied on said cladding layer of the semiconductor layer sequence." Support for this feature may be found in Figs. 1 and 2 and in par. [0035] of the originally filed specification. No new matter has been added.

Lee relates to "the structure of a light-emitting diode (LED) and method of manufacturing the same, which uses the contact between the bonding metal and the semiconductor as a Schottky barrier to block and spread the current therein" (see col. 1, lines 6-10).

The Examiner contends:

> Lee discloses a light-emitting diode chip in fig. 3C having an epitaxial semiconductor layer sequence (31/32/33) with an active zone 32, column 3 line 27, that emits electromagnetic radiation and an electrical contact structure (34/35/36) comprising a radiation-transmissive electrical current expansion layer 35 which contains ZnO, column 3 line 31, and an electrical connection layer 36, column 4 line 5, wherein the current expansion layer 35 comprises a window, in which the connection layer 36 is applied on a cladding layer 33, column 3 line 27, of the semiconductor layer sequence, the connection layer 36 is electrically conductively connected to the current expansion layer 35, and the junction between the connection layer 36 and the cladding layer 33, during the operation of the light-emitting diode chip, is not electrically conductive (Schottky barrier), column 3 line 3 line 60-65, or is only so poorly electrically conductive that the entire, or virtually the entire, current flows via the current expansion layer 35 into the semiconductor layer sequence.

With respect to the foregoing statement, the following is noted. According to *Lee*, a transparent electrode 35 and a contacting metal 36 are applied on different layers, i.e. the transparent electrode 35 is formed on a p-type contact layer 34 and the contacting metal 36 is formed in a hole on a cladding layer 33, wherein the hole passes through the transparent electrode 35 and the p-type contact layer 34 (see Fig. 3C; col. 4, lines 18-24).

As taught in *Lee*, the current expansion layer (i.e., the transparent electrode 35) is not applied on the same semiconductor layer on which the connection layer (i.e., metal 36) is applied. Rather, there is an intermediate layer (i.e., p-type contact layer 34) between the current expansion layer (i.e., the transparent electrode 35) and the cladding layer 33. Consequently, *Lee*

fails to teach the limitation "the current expansion layer is applied on a cladding layer of the semiconductor layer and comprises a window, in which the connection layer is applied on said cladding layer of the semiconductor layer sequence" as set forth in amended independent claim 1.

Lee teaches a direct electrical contact between the connection layer (i.e. metal 36) and the intermediate semiconductor layer (i.e., p-type contact layer 34), since the Schottky barrier 38 only exists between the connection layer (i.e. metal 36) and the semiconductor layer 33 (i.e., cladding layer 33) (see Fig. 3C). Hence, a significant portion of current injected into the LED does not pass through the transparent electrode 35. Rather, this current is directly injected into the intermediate semiconductor layer, i.e. p-type contact layer 34. However, semiconductor layers generally have a much higher sheet resistance than current expansion layers containing ZnO. Consequently, the level of current spreading in such a device is worse than the level of current spreading in a device with a contact structure that includes ZnO.

With the electrical contact structure of *Lee*, an unnecessarily high level of light will be generated directly below the connection layer 36 (i.e. metal 36). This is disadvantageous because light generated under the intermediate semiconductor layer (i.e., p-type contact layer 34) is more likely to be absorbed by this layer. In contrast, the invention recited in amended claim 1 reduces the likelihood of absorption of light that is generated in regions of the LED that are laterally remote from the electrical contact layer. In view of the foregoing, *Lee* fails to teach the invention recited in amended independent claim 1. Consequently, reconsideration of the rejection under 35 U.S.C. §102(b) is in order, and a notice to that effect is earnestly solicited.

Patentability of the Claims Under 35 U.S.C. §103(a)

Claim 6 stands rejected under 35 U.S.C. §103(a) as being obvious over *Lee* in view of U.S. Patent No. 6,693,352 ("*Huang*"). Claims 7-8 stand rejected under 35 U.S.C. §103(a) as being obvious over *Lee* in view of U.S. Publication No. 2003/0059972 ("*Ikeda*"). Claim 9 stands rejected under 35 U.S.C. §103(a) as being obvious over *Lee* in view of U.S. Patent No. 6,074,889 ("*Sasaki*"). Claims 10-13 stand rejected under 35 U.S.C. §103(a) as being obvious over *Lee* in view of U.S. Patent No. 6,346,719 ("*Udagawa I*"). Lastly, claims 14-21 stand rejected under 35 U.S.C. §103(a) as being obvious over *Lee* in view of JP 2001036131 ("*Udagawa II*"). For the following reasons, Applicants respectfully assert that all claims of the present application distinguish the invention patentably over the combination of the cited references.

Huang relates to "a contact structure for group III-nitride, group III-phosphide, and group III-arsenide based a light emitting diode (LED), a laser diode (LD) and a photodiode (PD)" (see col. 1, lines 12-14). *Huang* fails to cure the deficiency of *Lee*. That is, *Huang* also fails to teach the electrical contact structure recited in amended claim 1.

Ikeda relates to "a light-emitting device having an oxide transparent electrode layer as an electrode for driving light emission, which is capable of enhancing the effect of improving the light extraction efficiency exhibited by such an oxide transparent electrode layer" (see ¶ [0009]). *Ikeda* fails to cure the deficiency of the semiconductor achieved by the combination of *Lee* and *Huang*. Specifically, *Ikeda* also fails to teach the electrical contact structure recited in amended claim 1.

Sasaki relates to a semiconductor light-emitting device, such as a light-emitting diode having a current diffusing layer (see col. 1, lines 11-14). However, the semiconductor achieved

by the combination of *Lee*, *Huang* and *Ikeda* fails to achieved the claimed semiconductor, because *Sasaki* also fails to teach the electrical contact structure recited in amended claim 1.

Udagawa I relates to "a high brightness AlGaInP light-emitting diode which comprises an upper cladding layer including three layers with different electron concentrations, and a metal oxide window layer" (see col. 1, lines 12-15). *Udagawa I* also fails to teach the electrical contact structure recited in amended claim 1.

Udagawa II relates to "reducing improving the light emitting efficiency of a semi conductor device by providing a specific layer in a light emitting part and an oxide layer in a window layer, respectively" (see Abstract). *Udagawa II* also fails to teach the electrical contact structure recited in amended claim 1.

Since neither *Lee* nor any of the cited references, applied individually or in combination, teach or suggest the claimed electrical contact structure, claim 1 is patentable over the combination of *Lee*, *Ikeda, Sasaki,* and the *Udagawa* references. Thus, reconsideration and withdrawal of all the rejections under 35 U.S.C §103 are in order, and a notice that that effect is earnestly solicited.

Dependent claims

In view of the patentability of amended independent claim 1, for the reasons presented above, each of dependent claims 2-21 and new dependent claims 22-26 is patentable therewith over the prior art.

Conclusion

Based on all of the above, it is respectfully submitted that the present application is now in proper condition for allowance. Prompt and favorable action to this effect and early passing of this application to issue are respectfully solicited.

Should the Examiner have any comments, questions, suggestions or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

Respectfully submitted,

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